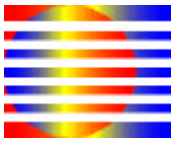

MULTISPECTRAL SOLUTIONS, INC.

Response to FCC Notice of Inquiry
ET Docket No. 98-153
"Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems."

Submitted to the
Federal Communications Commission, Washington, DC

By
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1. Introduction

Multispectral Solutions, Inc. (MSSI) is pleased to submit this third response to the Federal Communications Commission (FCC) Notice of Inquiry, ET Docket No. 98-153, pertaining to "Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems." MSSI has significant experience in the design, development, test & evaluation, and deployment of ultra wideband systems for communications, radar, precision geolocation and other applications.

This document addresses the request by Time Domain Corporation to have ultra wideband (UWB) systems classified as Class B digital devices. In this response, we again recommend to the Commission that:

1. UWB should *not* be considered as a Class B emission, since such a classification may

    (a) Because of the manner in which UWB emissions may be measured, permit the development and deployment of UWB devices which can cause serious interference to existing services; and

    (b) Destroy the commercial viability of UWB communications systems.

2. UWB *should* be considered as an intentional emission and, as such, operate outside of restricted bands[1].

2. Why UWB should not be considered a Class B emission

According to FCC Part 15, Section 15.3, a Class B digital device is one that is "marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public."

From Section 15.109 "Radiated Emission Levels", the field strength of radiated emissions from a Class B unintentional radiator shall not exceed (at a distance of 3 meters):

30-88 MHz	100 μV/m
88-216 MHz	150 μV/m
216-960 MHz	200 μV/m
Above 960 MHz	500 μV/m.

[1] Further discussion of the interference potential of UWB emissions below 2 GHz was presented in MSSI's ET 98-153 NOI response dated 1 March 2000.

At the highest field strength value of 500 μV/m, the average power at the source therefore cannot exceed

$$P_{ave} = \frac{E^2 R^2}{30} = \frac{\left(500 \times 10^{-6}\right)^2 (3)^2}{30} = 75nW$$

as measured in a 1 MHz bandwidth.

Example

Consider a 1 GHz bandwidth UWB waveform with spectral content contained above 960 MHz. The *true* average power – assuming a flat power spectral density – will be 1000 times larger than 75 nW, or

$$P_{ave}(true) = 75mW.$$

The true *peak* power is then obtained by backing out the waveform's peak-to-average ratio. Note that up to a 60 dB peak-to-average ratio is being contemplated by the FCC for UWB emissions.

With a maximum 60 dB peak-to-average ratio, the peak power for this example could be as high as

$$P_{peak}(true) = 75\,W$$

and still be allowable as a Class B UWB emission.

Of course, with a 1 GHz bandwidth, the pulsewidth is roughly 1 ns and a 60 dB peak-to-average ratio would correspond to a pulse repetition frequency (PRF) of 1000 pulses per second (i.e., 1 millisecond interarrival time).

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The following Table illustrates additional combinations of bandwidth, peak power and pulse repetition frequencies which would satisfy these modified rules. (Note that operation above 960 MHz is assumed for these calculations.)

Bandwidth	Pulse Repetition Frequency	Peak-to-Average Ratio	Allowed Peak Power
500 MHz	500	60.0 dB	37.5 W
(37.5 μW ave)	1e3	57.0 dB	18.75 W
	1e4	47.0 dB	1.88 W
	1e5	37.0 dB	188 mW
	1e6	27.0 dB	18.8 mW
	10e6	17.0 dB	1.88 mW
1000 MHz	1e3	60.0 dB	75.0 W
(75.0 μW ave)	1e4	50.0 dB	7.5 W
	1e5	40.0 dB	750 mW
	1e6	30.0 dB	75 mW
	1e7	20.0 dB	7.5 mW

The following observations can be made from the above discussion. With UWB considered as a Class B emission:

1. **High data rate applications are severely penalized in power** – For example, a 20 Mb/s UWB indoor wireless LAN application, utilizing a 1 GHz bandwidth above 960 MHz, would have a peak power limitation under these regulations of only 3.75 milliwatts. As indicated in MSSI's response from 1 March 2000, it is the *peak* power which determines communications range for a UWB pulse system.

   For comparison, a 20 Mb/s U-NII indoor application (5.15 - 5.25 GHz) can utilize an effective radiated power (ERP) of 200 mW, over 17 dB greater. In addition, this is over a significantly smaller (100 MHz vs. 1 GHz) bandwidth.

   Point-to-point U-NII applications (5.725 - 5.825 GHz) can utilize ERP's of 4W, or over 30 dB greater power levels than for UWB operating with a GHz bandwidth. At a 100 MHz bandwidth, a UWB emitter's peak power is restricted to 37.5 *microwatts*, an *additional* 20 dB loss!

   Thus, by designating UWB as unintentional Class B emissions, the FCC would essentially eliminate the commercial viability of UWB technology for any high-speed wireless applications.

2. **Under the proposed rule change, low to medium data rate communications, as well as most radar applications, can utilize extremely high peak power limits which can potentially result in significant interference to other services** – This does not seem to be the intent of FCC Part 15 regulations.

> Since Class B emissions can span restricted bands, the potential for UWB interference to such services as GPS, safety-of-flight and safety-of-life frequencies would be significant if these power levels are permitted.
>
> **Thus, because of the manner in which UWB systems operate, designating UWB as unintentional Class B emissions would potentially result in severe interference to existing services.**

If it is the intent of the Commission to allow UWB transmissions within restricted bands below 2 GHz; then by allowing such emissions to be classified as for Class B digital devices, the Commission may, on the one hand, be destroying the commercial viability of this new technology and, on the other, create the potential for serious and catastrophic interference to existing wireless services below 2 GHz.

As pointed out in MSSI's response to the Commission dated 1 March 2000, UWB systems are more properly classified as a superclass of spread spectrum waveforms; and, as such, are best characterized by a peak power constraint. Given such a peak power constraint, an increasing peak-to-average ratio now has the benefit of lowering the average power transmitted and received.